

LiDAR :

What is it?

How does it work?

How can we get it?

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Courtesy of Dodson & Associates

Iowa Department of Natural Resources - GIS Group



Slide courtesy of USGS

LiDAR Components

Light Detection and Ranging

- Aircraft
- Laser Rangefinder
- IMU (Inertial Measurement Unit)
- GPS (Global Positioning System)
- On board computer

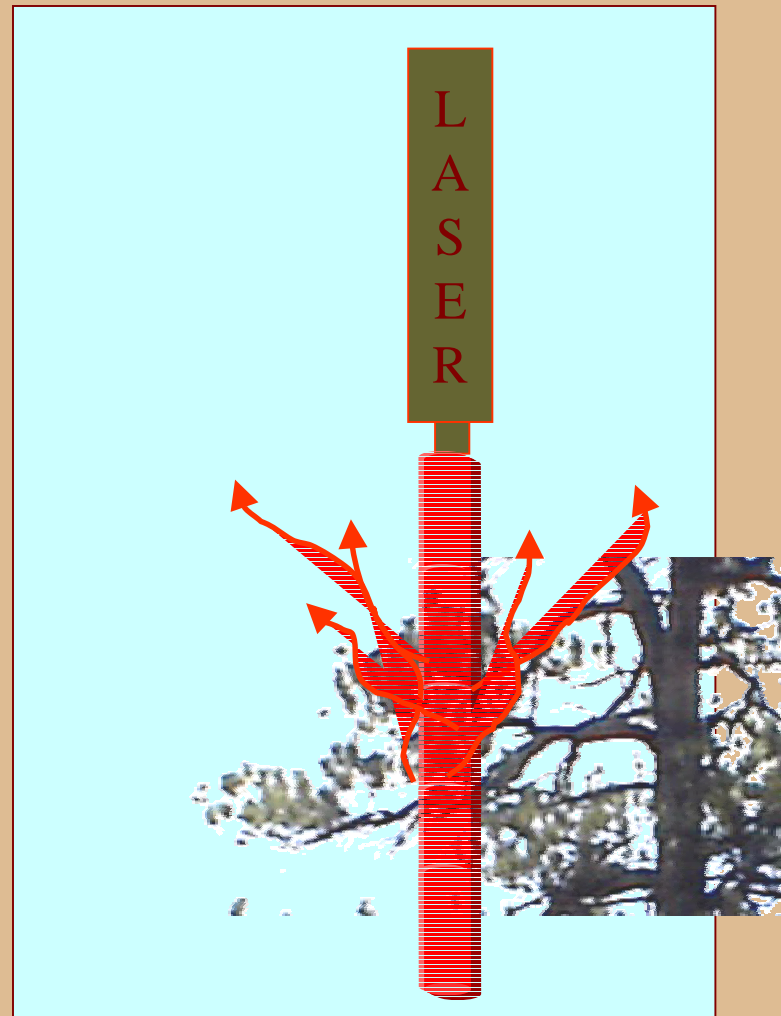
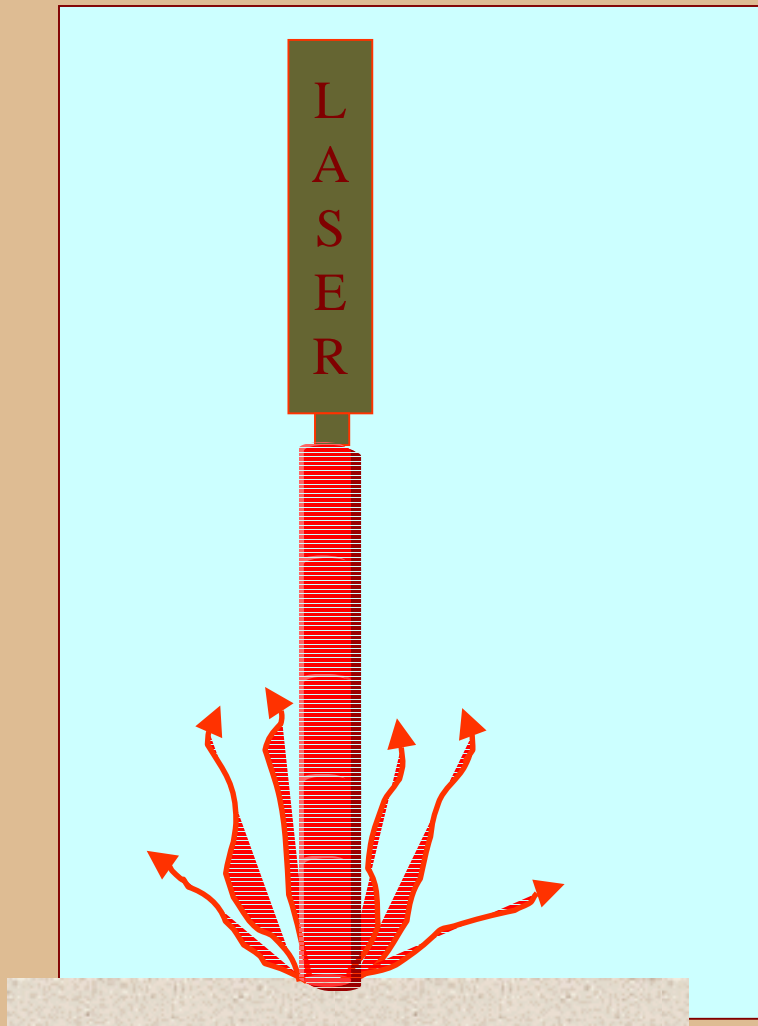


Laser Rangefinder

- **Records**
 - Time pulse leaves
 - Time pulse returns
 - Intensity of return
- **Calculates**
 - distance to target
 - $\text{Time} * \text{speed of light} / 2$



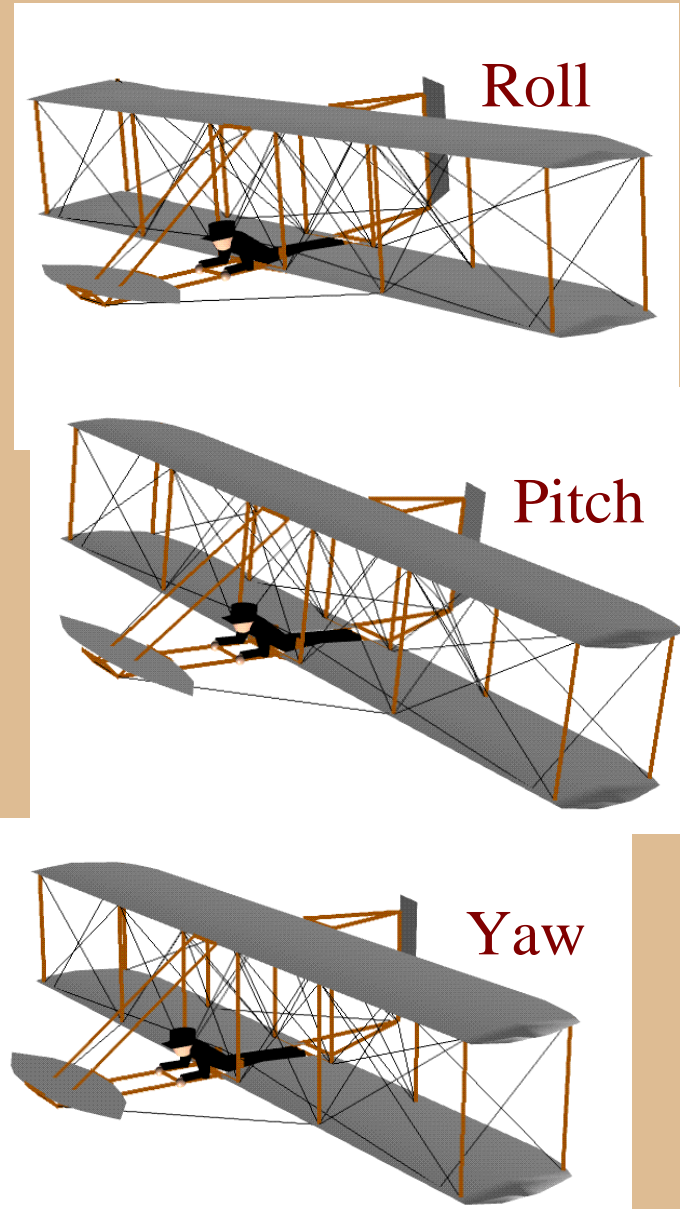
LiDAR Laser



IMU

Inertial Measurement Unit

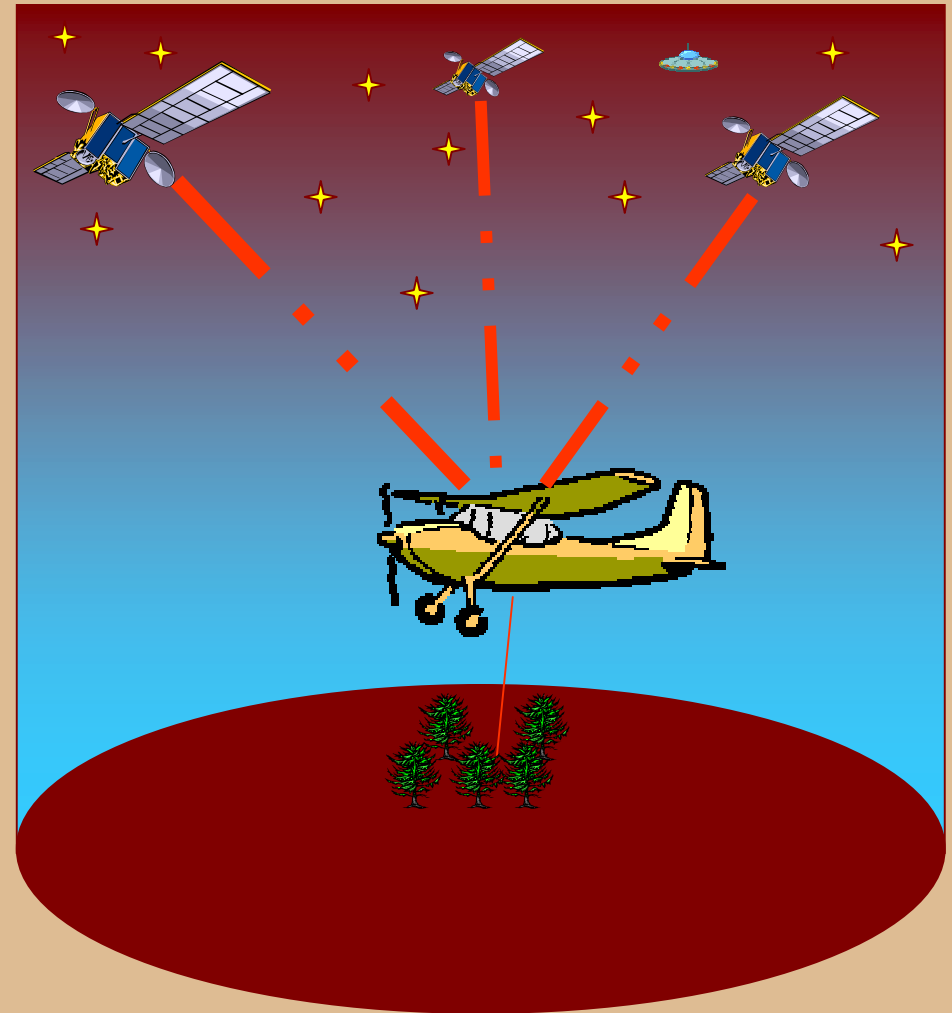
- Gyroscopes and accelerometer
- Records roll, pitch, yaw of aircraft
- .005 degree pitch & roll
- .008 degree heading



GPS

Global Positioning System

- Differentially corrected
- Provides cm accuracy of aircraft
- Allows cm accuracy of laser pulse



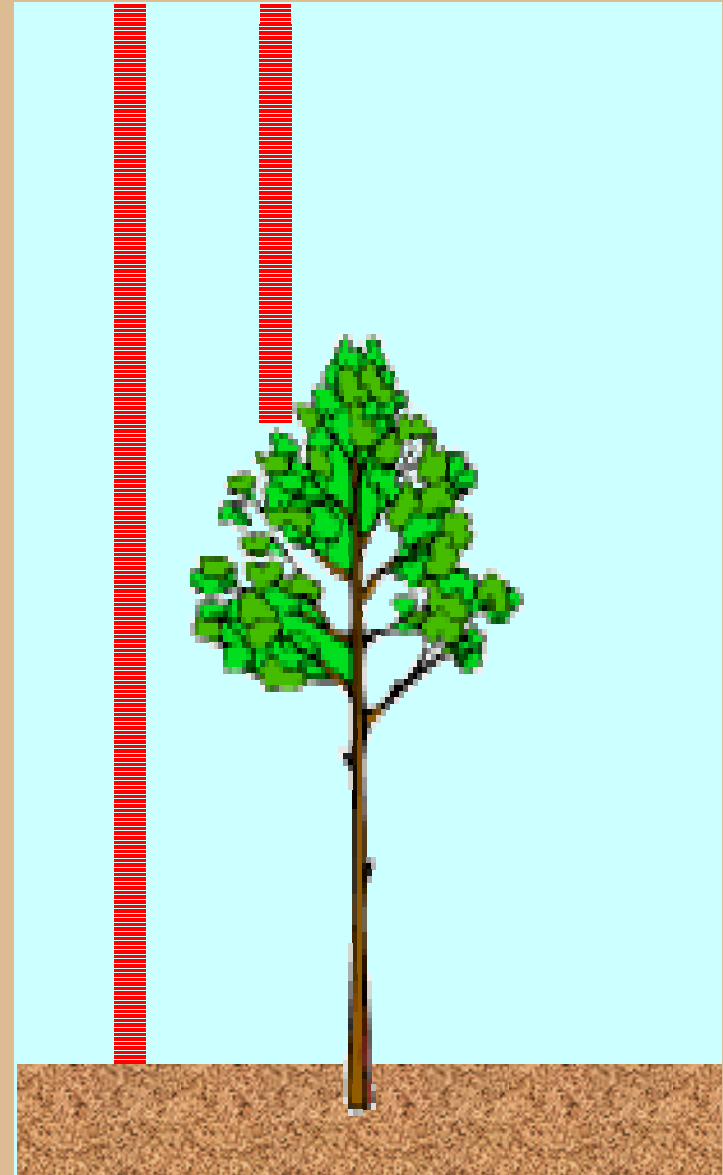
On-board Computer

- **Records data**
 - **Laser distance (intensity)**
 - **IMU info**
 - **GPS info**
- **Converts into X, Y, Z**
 - **Millions of points**
- **On-board display**



Returns

- **Single Return**
- **Multiple returns**
- **Waveform Returns**



Returns

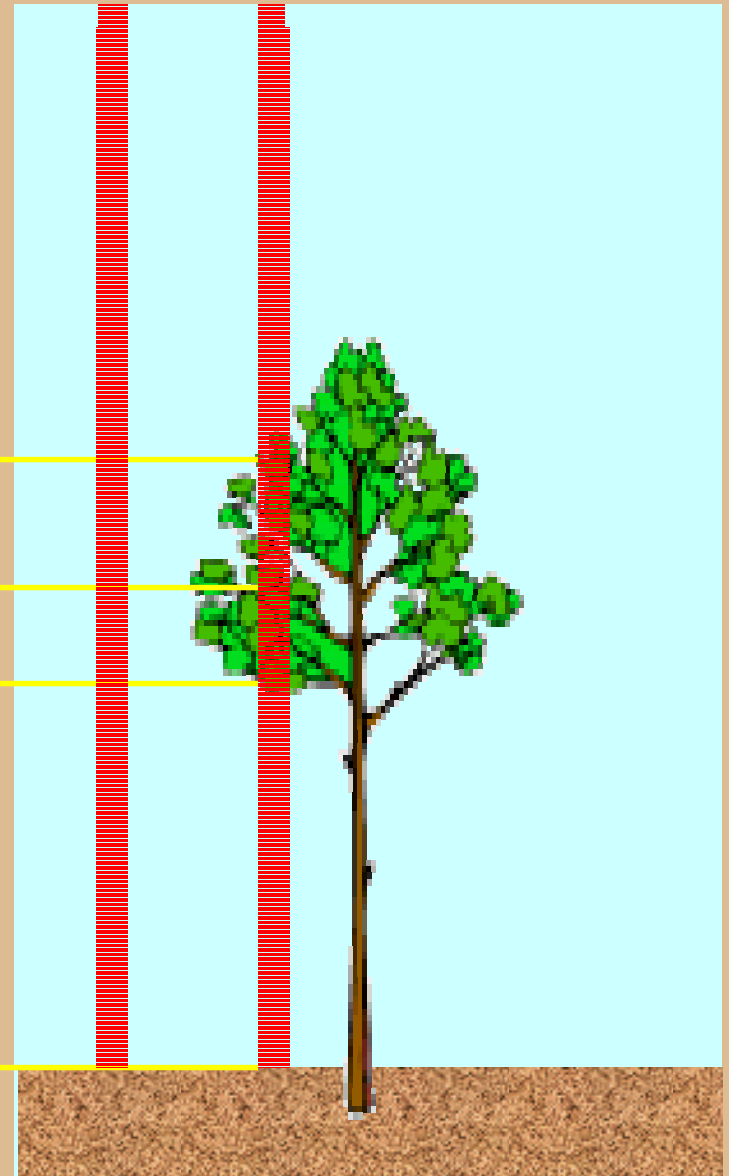
- **Single Return**
- **Multiple returns**
- **Return Intensity**

1st return

2nd return

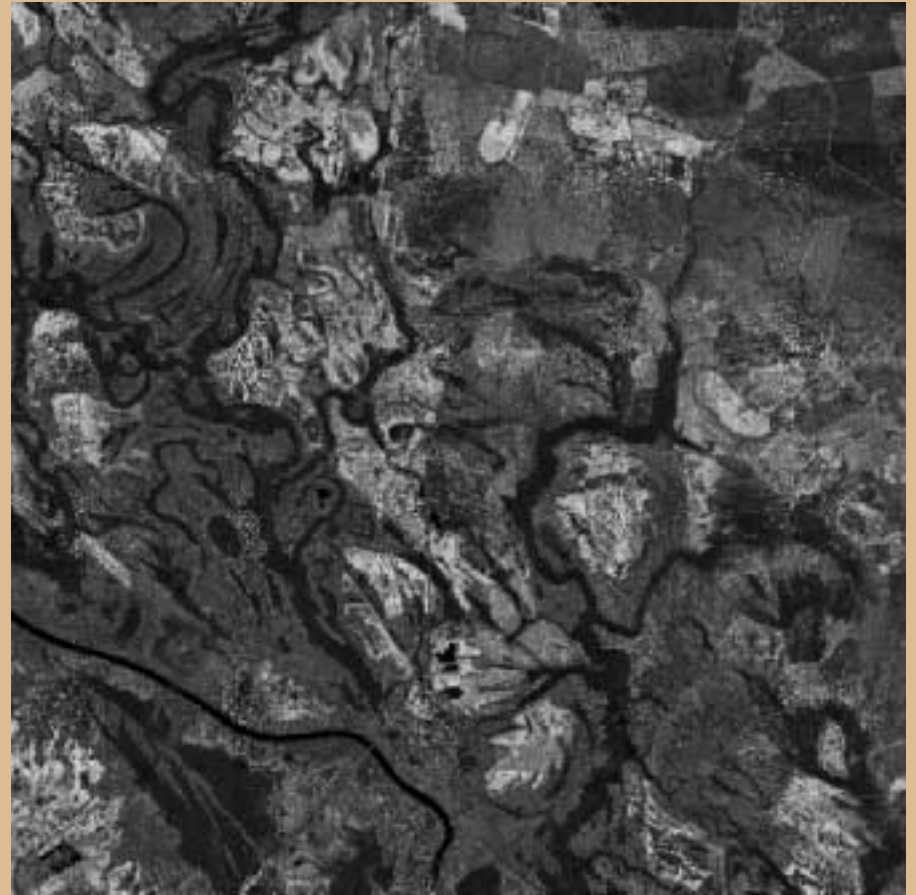
3rd return

4th return



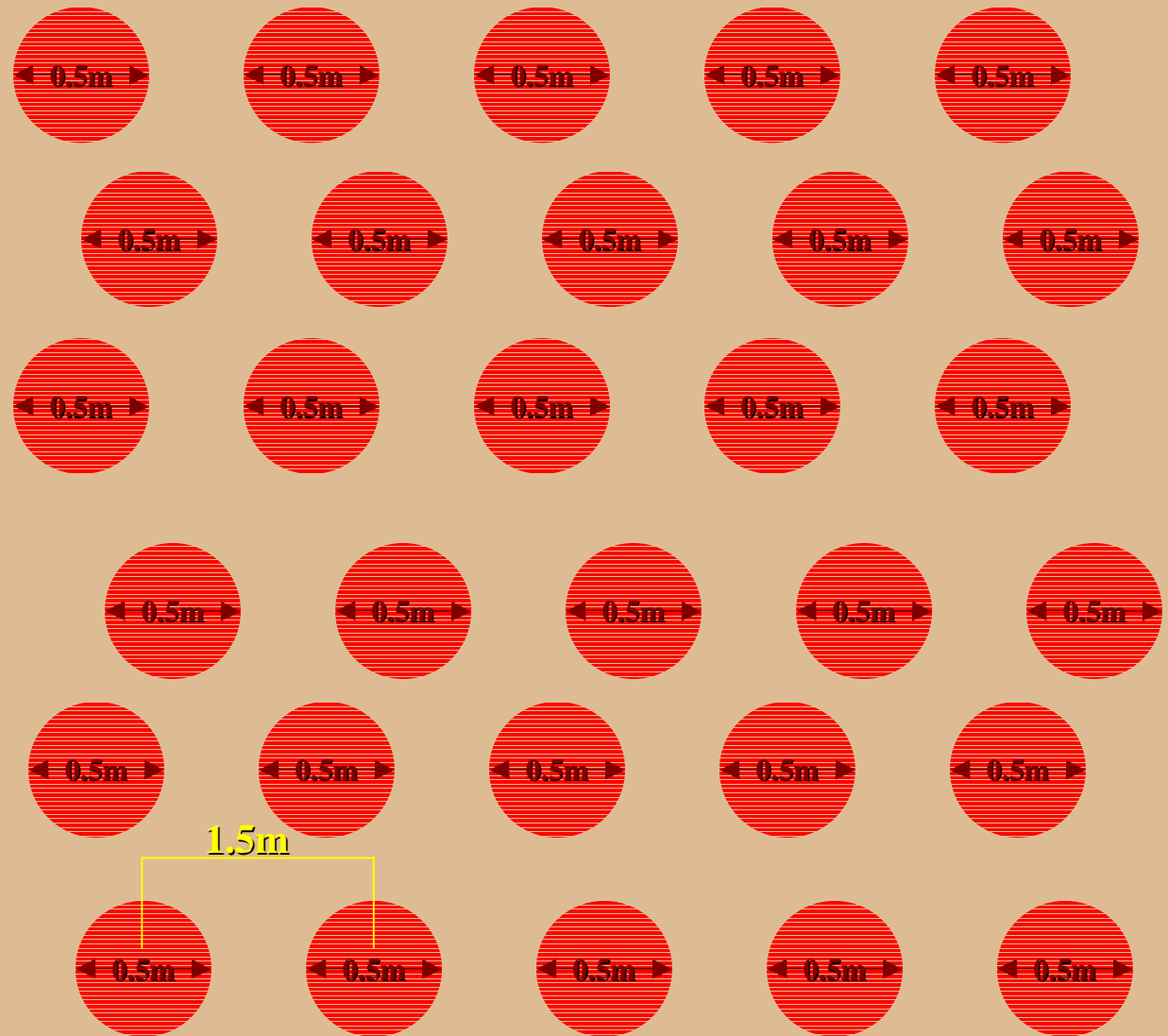
Intensity

- **Intensity = amount of energy reflected for each return**
- **Different surfaces reflect differently**



Posting Density

- Returns called “postings”
- Function of:
 - Laser pulse rate
 - 50,000/second
 - Flying ht/speed
 - Scan angle
 - Not regular interval

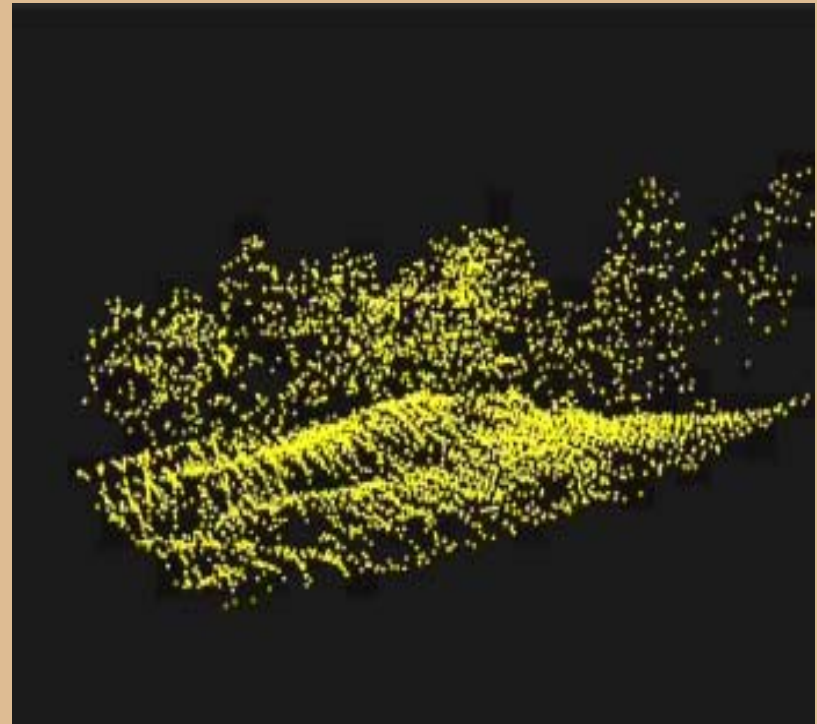


Error Budget

- **Laser rangefinder error = 0.8-1.2 inches**
- **GPS error = 2.0-3.9 inches**
- **IMU error = 10.6 inches @ 10,000 feet**
 - Usually flown around 2,000 - 4,000 feet
 - Yields error of 2.0-3.9 inches
- **Most vendors quote**
 - 6.0-7.0 inch vertical accuracy
 - 18 inch horizontal (depends on ht)

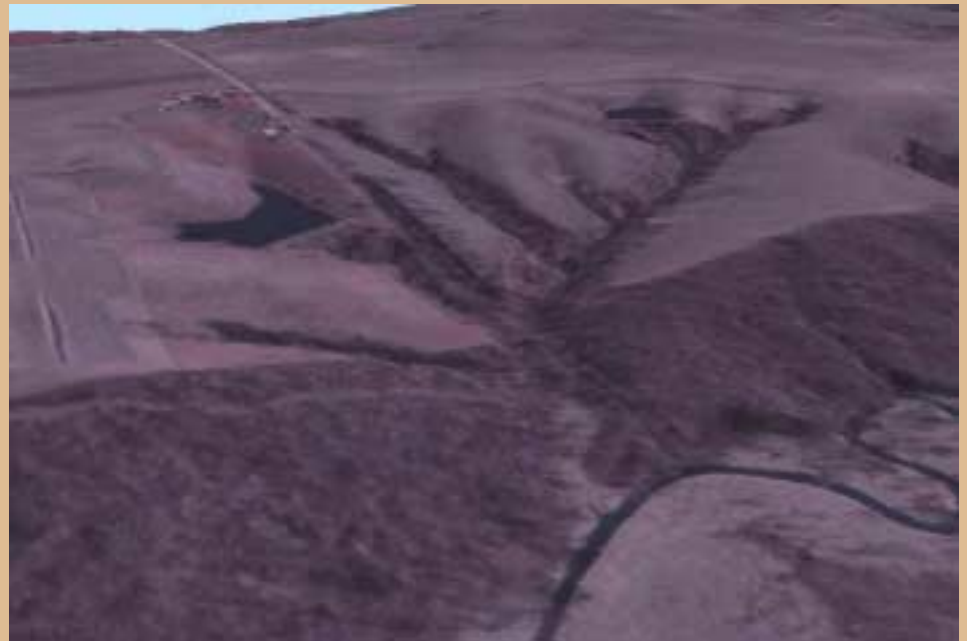
LiDAR Representations

- Point Cloud
- **Triangulated Irregular Network (TIN)**
- **Raster**

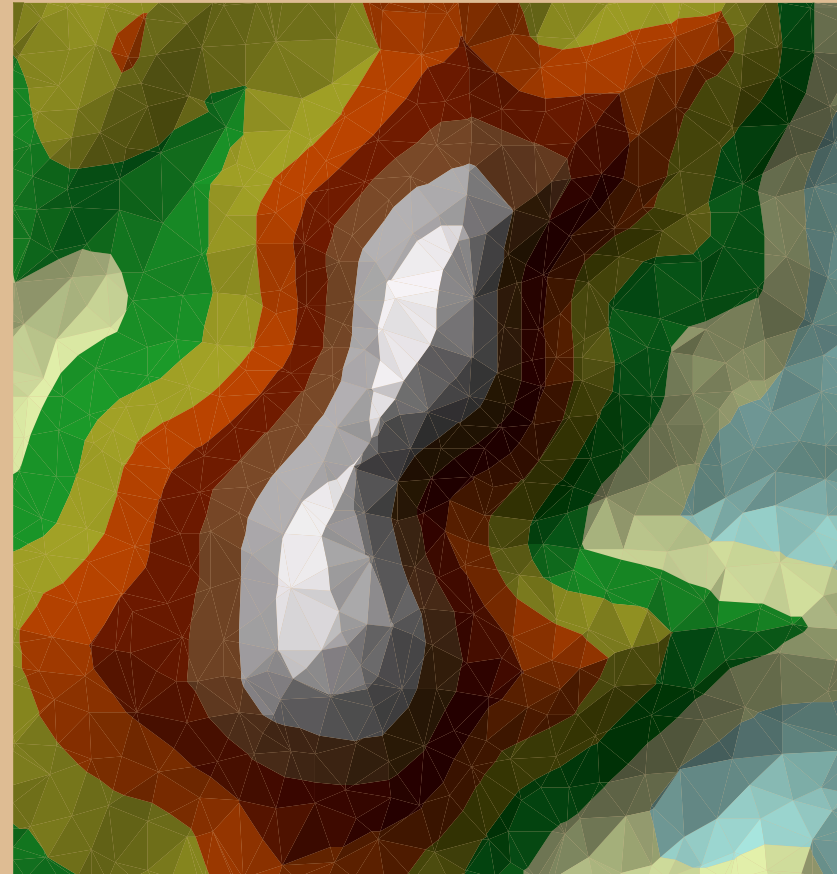
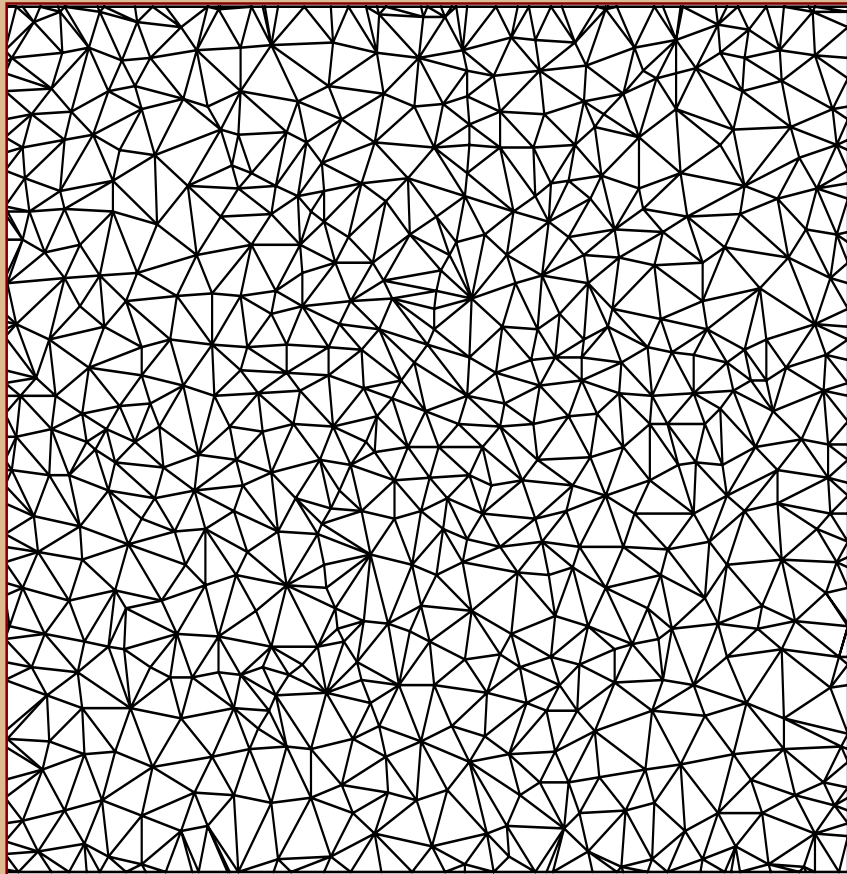


LiDAR Representations

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- **Triangulated Irregular Network (TIN)**
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TIN Triangles Hillshaded and Colored by Elevation



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